

A NEW CACTUS-FEEDING BUT SOIL-BREEDING SPECIES
OF *DROSOPHILA* (DIPTERA: DROSOPHILIDAE)

William B. Heed

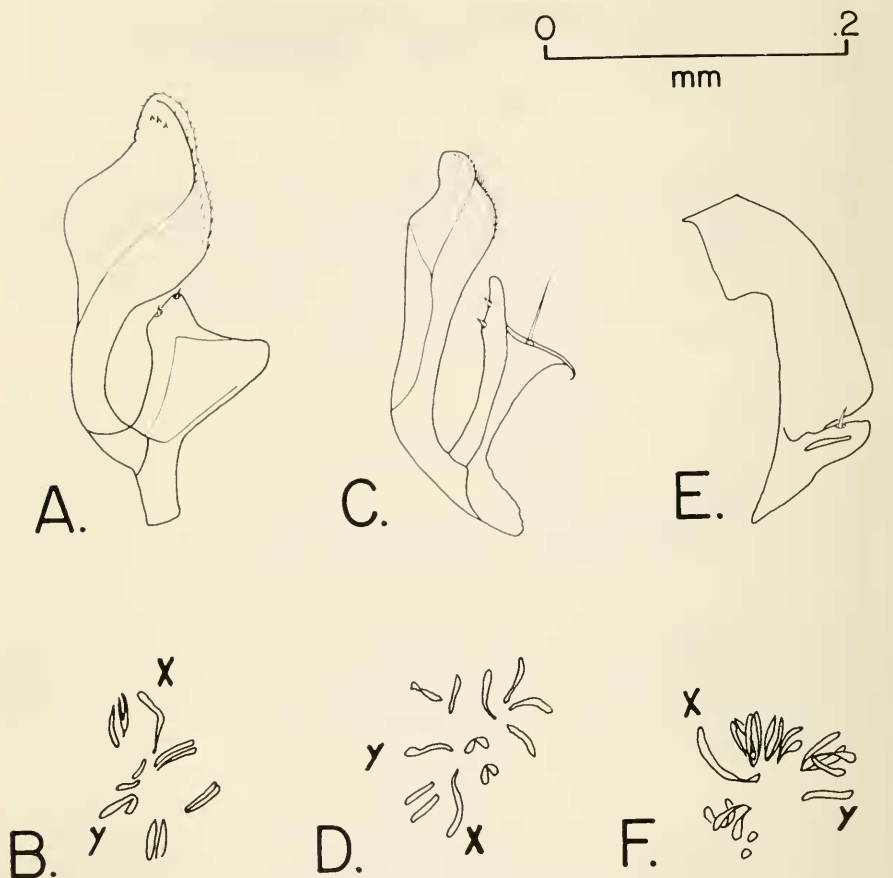
Abstract.—A new species of *Drosophila*, *D. mettleri*, is described from the Sonoran Desert. It is most closely related to *D. eremophila* Wasserman which belongs to the *mulleri* subgroup of the *repleta* species group of the subgenus *Drosophila*. Its most distinguishing characteristic is its habit of breeding in soil saturated by juice from the necrotic tissues of its host plants of the genera of columnar cacti, *Carnegiea* and *Pachycereus*.

This species was first observed in a banana-baited collection of *Drosophila* in October 1961, at San Felipe, Baja California. It has since been recognized as one of the four endemic species of *Drosophila* of the Sonoran Desert where the adults may be regularly collected in association with *D. nigrospiracula* Patterson and Wheeler from certain species of decaying columnar cacti. The species is morphologically very similar to *D. nigrospiracula* but it is not closely related to it. The species has been reported as *Drosophila* M or as *D. nigrospiracula*-like in the following publications: Heed et al., 1962; Johnston and Heed, 1971; Fellows and Heed, 1972; Kaneshiro et al., 1973; Jefferson et al., 1974; Heed et al., 1976; and Starmer et al., 1976. The description of the new species follows.

Drosophila mettleri Heed, new species

External characters of imagines.—♂ ♀, arista with 3-4 dorsal rays in addition to terminal fork. Third antennal segment and face yellowish brown. Carina wider below and slightly sulcate. Frons pollinose, golden brown in pinned specimens, somewhat elongated anteriorly with a central irregular cluster of 15-20 bristles and 6 bristles at anterior edge. Anterior proclinate bristle about same length as posterior reclinate. Mid-orbital $\frac{1}{3}$ - $\frac{2}{5}$ posterior. Eye almost round, dark red (maroon). Cheek very wide, about $\frac{1}{2}$ greatest diameter of eye, light brown. One strong oral with 2-3 suborals.

Mesonotum ground color pollinose lichen-gray (pinned specimens) with a dark brown spot at base of acrostichal hairs. Many spots fused forming irregular pattern. Eight acrostichal hair rows between dorsocentral bristles. Anterior scutellar bristles convergent. Pleural region dark gray. Anterior sternopleural $\frac{7}{10}$ length of posterior; mid-sternopleural $\frac{1}{3}$ or more posterior. Femora dark brown, remainder of legs light brown. Wing clear, costal index about 3.3; 4th vein index about 1.5; 5th index about .9. Third costal section with heavy bristles on basal $\frac{1}{3}$ - $\frac{1}{4}$. Abdomen with wide blackish bands very slightly interrupted on mid-dorsal line and extending to lateral margins.



Figs. A and B. *Drosophila mettleri*, Tucson, Arizona. A, lateral view of aedeagus with part of hypandrium attached to gonapophysis. B, larval brain cell metaphase. Figs. C and D. *Drosophila eremophila*, Navojoa, Sonora, Mexico. C, lateral view of aedeagus with part of hypandrium attached to gonapophysis. D, larval brain cell metaphase. Figs. E and F. *Drosophila nigrospiracula*, Tucson, Arizona. E, lateral view of aedeagus. F, larval brain cell metaphase.

Body length (etherized), 2.5–3.2 mm (δ), 2.7–3.7 mm (η); wing length 2.5–3.2 mm (δ), 2.5–3.4 mm (η).

Internal characters of imagines and genitalia.—Posterior tips of Malpighian tubules fused with continuous lumen. Testis with $3\frac{1}{2}$ orange coils; two orange coils in the differentiated section of the vas deferens. Testes become dark red with age. Claspers rounded with 11–12 primary teeth and no secondary teeth; about 15 heavy bristles on anterior margin. Tip of anal plate slightly elongated with a cluster of 3–5 bristles. Genital arch with

slightly rounded protrusion over claspers and with elongated toe extending beyond claspers. Novasternum with one heavy bristle and gonapophysis with two short bristles in tandem at terminal end. Aedeagus rounded in lateral view with no projections, apodeme short (Fig. 1). Stalks of spermathecae relatively long and weak. Capsule of spermatheca weakly sclerotized and somewhat crumpled. Ventral receptacle relatively short with a few basal coils and about 15 irregular folds distally where the diameter is much narrower. Ovipositor plate slightly blunted at tip with about 19 bristles.

Egg.—Two pair of long thin filaments about $1.5-2\times$ length of egg.

Larva.—Third instar mouth hooks are finely serrated under high magnification but with no teeth. The larvae are photonegative.

Puparium.—Tan color; horns, including the yellow spiracles, short, about $\frac{1}{2}$ length of pupa. Spiracles number 13, about same length as the stalk.

Chromosomes.—Six pairs of rods. The X is the longest rod and the shortest rod represents the dot chromosome with added heterochromatin. It is approximately $\frac{2}{3}$ length of the X. The Y is $\frac{2}{3}$ length of X and is J-shaped. Salivary chromosomes show 5 arms and a heavily heterochromatized dot.

Distribution and ecology.—Breeds in the soil saturated with fermenting cactus juice from three columnar cacti (*Carnegiea gigantea* (Engelmann) Britton and Rose (saguaro), *Pachycereus pringlei* (S. Watson) Britton and Rose (cardon) and *Pachycereus pecten-arboriginum* (Engelmann) Britton and Rose (hecho)) in the Sonoran Desert of Arizona, Baja California and Sonora, Mexico, where they occur. The species is invariably associated with *D. nigrospiracula* which breeds in the necrotic tissues of these plants.

Relationship.—Belongs to the *mulleri* subgroup of the *repleta* species group of the subgenus *Drosophila* and is most closely related to *D. eremophila* Wasserman from which it may be distinguished by the larger size, metaphase chromosomes, breeding biology and distribution. The metaphase chromosomes of *D. eremophila* have a pair of short heterochromatic V's in place of the short rods of *mettleri* and the Y is shorter and not J-shaped. The author has examined the metaphase of *D. eremophila* from Guayalejo, Tamaulipas, Mexico, and from Navojoa, Sonora, Mexico. They are almost identical and differ from the type-material from Acatlan, Puebla, as reported by Wasserman (1962), by the length of the Y. In strains from the former two localities the Y is about $\frac{1}{2}$ length of the X while it is only dot-sized in the material from Acatlan.

The banding sequences on the polytene autosomes of *mettleri* are identical (homosequential) with those of *eremophila*. The X chromosome has not been interpreted (Wasserman, personal communication).

Drosophila eremophila adults are associated with *Opuntia* pads in Navojoa, Sonora, but they have never been reared from them. It is assumed they breed in the soil because of their close relationship to *D. mettleri*

Table 1. Distribution of adults and larvae of *Drosophila mettleri* and *D. nigrospiracula* on saguaro.

	Aspirated on ground		Aspirated on cactus		Eclosed in laboratory		Days to eclosion
	♀	♂	♀	♂	soil	cactus	
<i>D. nigrospiracula</i>	1	1	27	38	0	2,208	6-22
<i>D. mettleri</i>	19	9	9	59	534	0	8-17

and especially in the close resemblance in shape of the larval mouth hooks. The two species are known to be sympatric in the locality of Empalme, Sonora.

Types.—Holotype male and paratypes from Tucson, Arizona, deposited in the U.S. National Museum, Washington, D.C. Other paratypes deposited in the National *Drosophila* Species Resource Center, University of Texas, Austin, Texas. The species is named in honor of Dr. Lawrence E. Mettler in recognition of his outstanding contributions to our knowledge of Sonoran Desert *Drosophila*.

Discussion

Drosophila mettleri is an interesting species in several respects. Primarily it represents one of the first cases in the genus *Drosophila* in which larvae and pupae are found in the soil and thus demonstrates a distinct niche separation from *D. nigrospiracula* whose larvae and pupae exist in the necrotic tissues of the parent cacti.

On 2 March 1972, *D. mettleri* larvae were first discovered in the soil by J. Spencer Johnston and the author. Table 1 shows a typical sample distribution of adults and larvae of the two species from a saguaro near Tucson. *Drosophila nigrospiracula* adults prefer to feed on the cactus while *D. mettleri* are found both on the soil and on the cactus. Females of *D. mettleri* are more abundant on the moist soil where they lay eggs. There is no overlap in this case between species reared from the soil and the cactus even though the cactus was collected immediately above the soil. There is a difference of emergence time of two days between the species; *D. mettleri* develops more slowly.

The other well studied case of paired species in a host plant and its soil exists in the Island of Hawaii in the extremely arid *Myoporum* forest of the Pohakuloa area at 6,000 feet elevation (Kaneshiro et al., 1973). However, in this case the two species, *D. silvarentis* Hardy and Kaneshiro (which breeds in the tree flux) and *D. heedi* Hardy and Kaneshiro (which

breeds in the moist soil beneath the flux) are considered to be very closely related. The two species in the Sonoran Desert are not each other's closest relatives. However, the common dimension in both cases is the arid condition in which they exist. Niche separation, as opposed to niche overlap, appears to be an ecological characteristic of more arid areas.

Secondly, the very close similarity in external features of the adults of *D. mettleri* and *D. nigrospiracula* must be the result of selection for a common phenotype (parallelism). This can be readily understood since the adults of both species feed side-by-side in an exposed condition on the necrotic tissues of their hosts. *Drosophila nigrospiracula* may be distinguished from *D. mettleri* by the following characters: (1) frons pollinose brownish black with a V-shaped row of approximately eight bristles, (2) there is no extension (toe) from the genital arch (δ), (3) aedeagus with a very poorly developed gonapophysis, (4) third-instar larval mouth hooks distinctly toothed, (5) anterior horns, including spiracles, about $\frac{1}{3}$ length of pupa; spiracles black, and (6) chromosomes, five pairs of rods and a pair of large dots. The Y is a rod and is over $\frac{1}{2}$ length of the X (Figs. B, D, F).

Drosophila mettleri sometimes overlaps *D. nigrospiracula* in the following characters which are listed for *nigrospiracula*: Larger size, blacker body, narrower cheek and more elongated and proportionately larger eye.

Acknowledgments

The author appreciates the generous help of J. Spencer Johnston, Richard H. Richardson, Alexander and Jean Russell, William T. Starmer, Lynn H. Throckmorton, Marvin Wasserman and Oscar G. Ward for their aid in various aspects of this work. This work was supported by NSF Grant No. DEB-7419148.

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Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, Arizona 85721.

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